

What is claimed is:

1 1. A silica-filled encapsulant composition for
2 electrical connections, comprising a "core-shell" substance
3 including a fine powder, whose particles each have an outer
4 shell with a glass transition temperature above room
5 temperature, and a core with a glass transition temperature
6 below room temperature.

1 2. The silica-filled encapsulant composition in
2 accordance with claim 1, wherein silica fill is in a range
3 of between approximately 40 and 60 percent by weight of the
4 total encapsulant composition.

1 3. The silica-filled encapsulant composition in
2 accordance with claim 1, wherein said encapsulant
3 composition has a toughness of between approximately 800 and
4 2,500 psi-in^{1/2}.

1 4. The silica-filled encapsulant composition in
2 accordance with claim 1, including a silane component.

1 5. The silica-filled encapsulant composition in
2 accordance with claim 1, including at least one from the
3 group of epoxy resins, polyimides, cyanide esters, and
4 combinations thereof.

1 6. The silica-filled encapsulant composition in
2 accordance with claim 5, wherein said epoxy resin comprises
3 a cycloaliphatic epoxy resin and/or a glycidyl epoxide
4 resin.

1 7. The silica-filled encapsulant composition in
2 accordance with claim 5, wherein said epoxy resin comprises
3 a cycloaliphatic epoxy resin in an approximate weight range
4 of between 14 and 25 percent by weight of the total
5 encapsulant composition.

1 8. The silica-filled encapsulant composition in
2 accordance with claim 2, comprising a cycloaliphatic epoxy
3 resin in an approximate weight range of between 14 and 25
4 percent by weight of the total encapsulant composition.

1 9. The silica-filled encapsulant composition in
2 accordance with claim 2, comprising a cycloaliphatic epoxy
3 resin and a methyl-hexa-hydrophthalic anhydride both
4 respectively in an approximate weight range of between 14
5 and 25 percent by weight of the total encapsulant
6 composition.

1 10. The silica-filled encapsulant composition in
2 accordance with claim 9, including a silane component.

1 11. A silica-filled encapsulant composition for
2 electrical connections, comprising:

1 a) silica fill in a range of approximately
2 between 40 and 60 percent by weight of the total encapsulant
3 composition; and

1 b) an epoxy resin and an anhydride both
2 respectively in an approximate weight range of between 14
3 and 25 percent by weight of the total encapsulant
4 composition.

1 12. The silica-filled encapsulant composition in
2 accordance with claim 11, wherein said composition has a
3 toughness of between approximately 800 and 2,500 psi-in^{1/2}.

1 13. The silica-filled encapsulant composition in
2 accordance with claim 11, including a silane component.

1 14. The silica-filled encapsulant composition in
2 accordance with claim 11, wherein said epoxy resin comprises
3 a cycloaliphatic epoxy resin and/or a glycidyl epoxide
4 resin.

1 15. The silica-filled encapsulant composition in
2 accordance with claim 11, wherein said anhydride comprises a
3 methyl-hexa-hydrophthalic anhydride.

1 16. A silica-filled encapsulant composition for
2 electrical connections, comprising:

3 a) silica fill in a range of approximately
4 between 40 and 60 percent by weight of the total encapsulant
5 composition; and

6 b) a cycloaliphatic epoxy resin and a methyl-
7 hexa-hydrophthalic anhydride both respectively in an
8 approximate weight range of between 14 and 25 percent by
9 weight of the total encapsulant composition.

1 17. The silica-filled encapsulant composition in
2 accordance with claim 16, wherein said encapsulant
3 composition has a toughness of approximately between 800 and
4 2,500 psi-in^{1/2}.

1 18. The silica-filled encapsulant composition in
2 accordance with claim 16, including a silane component.

1 19. The silica-filled encapsulant composition in
2 accordance with claim 16, including 2-ethyl-4-
3 methylimidazole as a catalyst.

1 20. The silica-filled encapsulant composition in
2 accordance with claim 16, further comprising a wetting
3 agent.

1 21. A method of encapsulating an integrated circuit
2 chip and a substrate associated therewith, said substrate
3 comprising organic materials, to form a chip carrier, the
4 steps comprising:

5 applying a silica-filled encapsulant composition
6 to an IC chip and associated substrate, said composition
7 comprising particles having a core material with a glass
8 transition temperature, T_g , below room temperature and a
9 core-shell material substantially surrounding said core
10 material, said core-shell material having a T_g above room
11 temperature;

12 curing said encapsulated IC chip and substrate;
13 and

14 reflowing solder joints between said IC chip and
15 said substrate.

1 22. The method of encapsulating an integrated circuit
2 chip and a substrate associated therewith in accordance with
3 claim 21, wherein silica fill is in a range of between
4 approximately 40 and 60 percent by weight of the total
5 encapsulant composition.

1 23. The method of encapsulating an integrated circuit
2 chip and a substrate associated therewith in accordance with
3 claim 21, wherein said encapsulant composition has a
4 toughness of between approximately 800 and 2,500 psi-in^{1/2}.

1 24. The method of encapsulating an integrated circuit
2 chip and a substrate associated therewith in accordance with
3 claim 21, including a silane component.

1 25. The method of encapsulating an integrated circuit
2 chip and a substrate associated therewith in accordance with
3 claim 21, including at least one from the group of epoxy
4 resins, polyimides, cyanide esters, and combinations
5 thereof.

1 26. The method of encapsulating an integrated circuit
2 chip and a substrate associated therewith in accordance with
3 claim 25, wherein said epoxy resin comprises a
4 cycloaliphatic epoxy resin and/or a glycidyl epoxide resin.

1 27. The method of encapsulating an integrated circuit
2 chip and a substrate associated therewith in accordance with
3 claim 25, wherein said epoxy resin comprises a
4 cycloaliphatic epoxy resin in an approximate weight range of
5 between 14 and 25 percent by weight of the total encapsulant
6 composition.

1 28. The method of encapsulating an integrated circuit
2 chip and a substrate associated therewith in accordance with
3 claim 22, wherein said composition comprises a
4 cycloaliphatic epoxy resin in an approximate weight range of
5 between 14 and 25 percent by weight of the total encapsulant
6 composition.

1 29. The method of encapsulating an integrated circuit
2 chip and a substrate associated therewith in accordance with
3 claim 22, comprising a cycloaliphatic epoxy resin and a
4 methyl-hexa-hydrophthalic anhydride both respectively in an
5 approximate weight range of between 14 and 25 percent by
6 weight of the total encapsulant composition.

1 30. The method of encapsulating an integrated circuit
2 chip and a substrate associated therewith in accordance with
3 claim 29, including a silane component.